

**City of Carnation 2004 Draft Sewer Facilities Plan,
Executive Summary**

CITY OF CARNATION



2004 SEWER FACILITIES PLAN

CITY REVIEW DRAFT – SEPTEMBER 2004

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EXECUTIVE SUMMARY

PURPOSE OF PLAN

The primary purpose of this Facilities Plan (henceforth, “Plan”) is to fulfill the requirements of WAC 173-240-060 as it relates to the design and construction of the new vacuum-based sanitary sewer collection system for the City of Carnation. The Plan is an engineering report and represents the next step in implementing the City’s 2004 Comprehensive Sewer Plan. The Plan provides design information sufficiently complete so that plans and specifications can be developed without substantial changes. Ultimately, this Plan must be approved by the Department of Ecology (DOE).

SCOPE AND ORGANIZATION OF PLAN

This Plan is organized into the following Sections plus Appendices:

- Section 1 – Introduction
- Section 2 – Planning Considerations
- Section 3 – Alternatives Analysis
- Section 4 – Sewer Collection System
- Section 5 – System Operation and Maintenance
- Section 6 – Project Cost and Timeline
- Appendices

A brief summary of each follows below. These summaries describe the contents of each Section and present the most significant data or information found therein. For more complete descriptions and information, direct reference to the appropriate Section is required.

Section 1 – Introduction

The Introduction delineates in more detail the Purpose of the Plan which has been summarized above. Also presented is a listing of the Plan Sections and their contents.

The City is located at the confluence of the Tolt and Snoqualmie Rivers in King County, Washington as shown on Figure 1-1, Vicinity Map. The City encompasses approximately 608 acres with an additional approximately 164 acres in its Potential Annexation Area.

The City has entered into an interlocal agreement with King County to have the County design, construct, operate, and maintain the wastewater treatment plant and disposal system for the City. A plan for the King County facilities is not included in this Plan, but is the subject of a separate facilities plan being prepared by the County.

A brief project description is presented wherein it is noted that the subject project for this Plan is the vacuum sewer system to serve the entire Urban Growth Area, i.e. the City limits

plus Potential Annexation Area. The City is presently proceeding with the design and construction of only that portion of the new sewer system which will serve those properties within the City limits.

Section 2 – Planning Considerations

The planning considerations have been adapted and abridged from the 2004 City of Carnation Comprehensive Sewer Plan.

The planning area, Urban Growth Boundary, and the planned sewer service Basins are shown on Figure 2-1, Planned Service Area Basins, wherein the 19 Sewer Basins are designated by the letters A – S. Land use and zoning are described and shown on Figures 2-2, Existing Land Use, and 2-3, Current Zoning.

Population and employment projections, by Sewer Basin, are presented in Tables 2.1 and 2.2 respectively for the years 2000, 2007, 2012, 2022, and 2030. In Table 2.3, the ultimate population and employment capacity by Sewer Basin is presented. The ultimate residential population for the Urban Growth Area is predicted as 3,871 residents and is expected to be attained by the year 2022. The ultimate employment level in the Urban Growth Area is predicted to be 2,825 employees but is not anticipated until after the year 2030.

Development of the criteria for projecting wastewater flows begins in Subsection 2.4. Flow criteria are developed for residential, commercial, Tolt MacDonald Park, school, and Remlinger Farms flows. Peak flow factors are also developed. The most significant flow factors are:

- Residential: 65 gpcd (gallons per capita per day)
- Commercial: 30 gpcd (gallons per employee per day)
- Carnation Middle School: 16 gpcd (gallons per student/staff per day)
- Future High School and Carnation Elementary School: 10 gpcd (gallons per student/staff per day)
- Remlinger Farms: 55 gpm (peak flow) (gallons per minute)
- Peaking Flow Factors: 3.0 for residential and commercial, 2.0 for schools based on an 8-hour day.

Applying the criteria for projecting wastewater flows with the population and employment forecasts results in the projected wastewater flow estimates presented in Table 2.4. As shown in the Table, the ultimate peak flow for the Urban Growth Area is predicted to be 975 gpm.

Conservation/Demand reduction is a goal of the City. The City encourages low flow plumbing devices. The estimated cost and benefit to the overall sewer project for major retrofit projects were evaluated and City specific benefit was found to be very small or nonexistent. The Council will take demand reduction measures when it is deemed to be beneficial to the City.

Both King County and the City are looking at potential applications for water reuse. At this point, the City is not installing a parallel “purple pipe” system along with vacuum system due to additional costs and complexity to the project. However, the City wants to retain the right to the reuse-grade reclaimed wastewater produced by the treatment plant.

Section 3 – Alternative Analysis

Section 3 presents a cost-effective analysis of two alternative sewer collection systems for the City, one based on a conventional gravity sewer system and the other based on a vacuum sewer system.

The advantages and disadvantages of both conventional gravity sewers and vacuum sewer systems are described. A gravity system will likely have higher capital costs but lower operations and maintenance costs versus a vacuum sewer system. A significant disadvantage of a gravity system is its potential vulnerability to infiltration/inflow relative to a vacuum sewer system, especially in an area with a high ground water table, such as Carnation.

The layout for a gravity sewer system alternative is presented in Figure 3-1, Gravity System Alternative, while the vacuum system alternative is shown on Figure 3-2, Vacuum System Alternative. These alternatives are described in Subsection 3.4 and are followed by the cost-effective analysis itself in Subsection 3.5.

In 2002, the Carnation City Council unanimously approved Agenda Bill AB02-21 determining that a vacuum sewer system is the preferred method of wastewater collection for the City. This analysis fulfills a requirement of the Facilities Plan by considering both the project (capital) costs and the operations and maintenance (O&M) costs using the federally mandated interest rate for the year 2004 of 4.875% to convert the capital costs to an equivalent annual cost.

The project (capital) cost and O&M estimates for the gravity sewer system are presented in Table 3.1 while similar costs for the vacuum sewer alternative are given in Table 3.2. The cost-effective analysis comparison of the two systems is presented in Table 3.3. The results in Table 3.3 are summarized below:

	<u>Gravity System</u>	<u>Vacuum System</u>
Equivalent annual project cost	\$857,785	\$787,875
Annual O&M cost	\$105,382	\$132,633
	-----	-----
Total Annual Cost	\$963,167	\$920,508

As shown, the vacuum sewer system, due to its lower initial capital cost, is the most cost effective alternative. This validates the decision that was made in 2002 that the vacuum sewer system was the most cost effective collection system for the City.

Section 4 – Sewer Collection System

Section 4 presents a detailed description of the selected vacuum sewer system alternative presented in Section 3. (Refer to Subsection 4.3). The description is based on the most recent preliminary design available at the time of this Plan's preparation. It can be anticipated that small modifications to the proposed layout will be required before the design is finalized due to, for example, the ease or difficulty of obtaining specific easements on private property.

Major features of the proposed system are that the entire City, including the PAA, will be served by a single vacuum pump station which will be housed in a building and provided with an emergency backup generator to keep the station operational during an electrical power outage. Influent to the vacuum pump station will be from five separate service areas. Each of the five service areas will be served by its own 10-inch diameter pipe entering the station. The vacuum pump station site will be located on City-owned property in the western part of the City (see Figure 3-2). A few grinder pump stations, either temporary or permanent, may be required to serve a few outlying services including Remlinger Farms.

The most important element in Section 4 is the design criteria presented in Subsection 4.2. These are the criteria to be used to design the City's sewer collection system. The wastewater flow criteria from Section 2 are presented in Subsection 4.2.1 in a summary format. In Subsection 4.2.3, the following design criteria are presented for the collection system piping:

Vacuum Valve	3-inch opening for solids passing
Vacuum Loss Limits	13 feet due to vertical lift 5 feet due to friction
Friction Loss Determination	Using modified Hazen-William equation as derived by AIRVAC®
Pipe Diameters	3-inches for valve pit connections 4 – 10-inches for collection mains
Pipe Layout Parameters	
Profile	“Sawtooth” pattern
Minimum slope between lifts	0.2% (downhill)
Pipe Length Restrictions	300 feet maximum for 3-inch service laterals 2,000 feet maximum for 4-inch diameter Determined by vacuum loss limits for > 4-inch
Access/Cleanout Locations	On 6-inch or larger mains only Where a change in pipe size is made At a minimum of every 1,500 feet

In Subsection 4.2.3 the design criteria for the vacuum pump station and force main to the King County treatment plant are given as shown below:

Peak Station Flow	975 gpm
Number of Vacuum Pumps	4, each rated 25 hp, 150 cfm minimum 1 space provided for future vacuum pump
Sewage Discharge Pumps	
Number	2, each rated for 25 hp, 975 gpm
Total Dynamic Head	50 feet (+/-)
Collection Tank	
Total System Volume	7000 gallons
Operating Volume	2300 gallons
System Pump Down Time (lower vacuum from 16 to 20 in Hg)	3 minutes maximum
Collection Tank Level Controls (from lowest to highest)	Ground probe Both discharge pumps stop Lead discharge pump start Lag discharge pump start High level alarm Reset for high level cutoff probe High level cutoff
Force Main	
Minimum velocity	2.5 fps
Maximum velocity	7 fps
Length	300 feet (+/-)
Diameter	10-inch

Some of the design criteria are derived from information made available from AIRVAC[®]. It should also be noted that information regarding the sewage pumps in the station is based on the assumption that King County's treatment plant will be located adjacent to the City's vacuum pump station. There is a possibility the County's treatment plant will be located in the southern part of the City and, if this happens, it would impact the design of the sewage pumps and force main. This is discussed more fully in the Section 4.

In Subsection 4.3.5 a brief statement explaining that infiltration/inflow is minimal in a vacuum sewer system is presented and explained.

Reproduced below (from Subsection 4.3.6) is Table 4.1, Design Flow Summary, which presents a summary of the planning year (2024) and ultimate design flows for the 5 main collection pipes (designated A through E on Figure 3.2), the vacuum station, and the County's treatment plant.

Table 4.1, Design Flow Summary				
	2024		Ultimate	
Location	Peak (gpm)	Max Month (mgd)	Peak (gpm)	Max Month (mgd)
Pipe A	196	---	196	---
Pipe B	222	---	237	---
Pipe C	177	---	177	---
Pipe D	187	---	200	---
Pipe E	165	---	165	---
Vacuum Station	947	0.49	975	0.53
Treatment Plant	975	0.49	975	053

Notes: (1) gpm = gallons per minute; mgd = million gallons per day

(2) Maximum month flows are derived from “Technical Memorandum No. 2, Population, Flow, and Loads”; September 2004; prepared for King County by Carollo Engineers, P.C.

The system is being designed based on the AirVac[®] design criteria and equipment. As described in Subsection 4.4, the City intends to acquire the AirVac[®] equipment through a ‘sole source procurement’ process whereby the City will negotiate the pricing in advance of the public bidding for the conveyance system construction contracts. The sole source procurement process is subject to the review and approval of regulatory agencies such as the DOE and EPA. The details of this process are being developed as of the time of this Plan preparation.

Section 5 – System Operations and Maintenance

In this Section, the existing operations and maintenance responsibilities are reviewed and recommendations on proposed staffing requirements and other related components that will be required of the City in order to operate and maintain its new sewer collection system are presented. Major recommendations are:

- Hire a new fulltime Public Works Maintenance Worker.
- Hire one new half-time office employee.
- Acquire new accounting software and appropriate computer hardware.
- Purchase a trailer mounted vacuum field test pump and general purpose backhoe.

Also presented in Section 5 is a recommended list of spare parts and preliminary recommendations for routine maintenance of the both the vacuum valves (at the service connections) and the equipment at the vacuum pump station.

Section 6 – Project Cost and Timeline

This Section presents the estimated cost impacts of the sewer collection system presently being designed on the City's citizens, a review of the necessary regulatory agency permits required for the project, and the anticipated schedule for completing the design and construction phases of the project. The project, as discussed in this Section, is limited to providing sewer service inside the City limits.

The most recent project cost estimate for the sewer system presently being designed is \$11,582,806. (Because the current project is limited to City-only service, this estimate is lower than the vacuum sewer estimate presented in Section 3 which was based on providing service throughout the Urban Growth Area.) Also not included in this estimate is King County's treatment and disposal facility which is budgeted at \$10.6 million.

The City has received PWTF loans and STAG grants to assist with the funding of the project. At the present time, the average monthly rate for a single family residence is predicted to be \$155, which includes costs for operating and maintaining the County's treatment facility. The City is actively seeking additional grant funding in order to lower the monthly customer costs. The City will apply for a DOE loan/grant of \$10 million in 2005.

The City is in the process of conducting a rate study to establish a rate structure for various types and sizes of properties. Most likely, the costs will be apportioned between General Facilities charges (the vacuum station and oversized lines) and Local Facilities charges (the lines providing service to properties) based on either land area or Residential Customer Equivalents or some combination thereof. Residential Customer Equivalents will be in accordance with the equivalents established by King County DNR. Residential Customer Equivalents for non-residential facilities will be based on a fixture count survey.

In general, the permits required for the project are a function of their location. Many of the required permits are under the jurisdictional authority of the City itself. These include: Zoning, Building, Street Use, Special Use, Grading, and Shoreline Substantial Development Permits.

Permit requirements from agencies other than the City include: Washington State Department of Fish and Wildlife Hydraulic Project Approval, King County Property Services Special Use Permit, King County DDES Shoreline Substantial Development Permit, King County DDES Public Agency Use Permit, and King County Wastewater Treatment Division Project Approval.

At this time, design of the Sewer Collection System is in progress with Final Plans and Specifications anticipated to be submitted to Department of Ecology for approval in December 2004. Contingent upon approval of this Facilities Plan and the Sewer Collection System Final Plans and Specifications, and successful acquisition of easements, advertisement of the project currently is planned for April 2005 with construction to start in June 2005.

Appendices

The following Appendices are included in this Plan:

- Appendix A – Interlocal Agreement between the City of Carnation and King County
- Appendix B – NEPA Environmental Assessment
- Appendix C – DOE Comments and Approval
- Appendix D – Adopting Resolution and Ordinance

The findings of the NEPA process, given in Appendix B, constitute an important element in the required content of the Plan.